

CLAIMS:

1. A backrest system for a chair for seating an individual, said chair having a seat and upright posts extending upwardly from the rear of the seat in a spaced apart, substantially parallel manner, said backrest system comprising:

5 a back support adapted to be positioned generally between the posts to provide a surface against which the back of an individual rests when the individual sits on the chair seat;

a support chassis mounted to said back support for supporting said back support at a desired incline with respect to said posts, and at a desired seat depth with respect to said seat;

and

10 an attachment assembly operably connected to said support chassis at two locations and to said posts to allow said support chassis and back support to be readily removed from or attached to said chair.

2. The backrest system as set forth in claim 1, wherein said support chassis further includes a pair of side plates with one side plate being disposed between each post and said back support, and at least one horizontal tube attached to and extending transversely between said side plates across said back support.

3. The backrest system as set forth in claim 2, wherein each of said side plates has a substantially horizontal slot formed therein which permits forward and rearward movement of said back support with respect to said posts to allow for said back support to be positioned 20 at the desired seat depth.

4. The backrest system as set forth in claim 3, wherein said support chassis further includes a pair of swivel clamps with each swivel clamp having a pair of slots formed

therein that permit angular movement of said back support with respect to said posts to allow said back support to be positioned at the desired incline.

5. The backrest system as set forth in claim 4, wherein said support chassis further includes fastening mechanisms that are inserted into said slots of said swivel clamp and said slots of said side plates to prevent further movement of said back support when said back support is positioned at the desired seat depth and the desired incline.

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6. The backrest system as set forth in claim 1, wherein said attachment assembly further includes a pair of bands with one band being positioned around each of said posts at a desired height, a pair of adapters having axially extending openings formed therein with one adapter being positioned opposite to said post inside each band, and at least one wedging mechanism positioned inside each band between said post and said adapter to force said band to remain in place along said post.

7. The backrest system as set forth in claim 6, wherein said attachment assembly further includes a pair of mounting devices attached to said support chassis for releasably securing said support chassis to said chair via said adapters, each mounting device including a mounting post attached to and extending outwardly from said support chassis, a barrel disposed at an outermost end of each mounting post, and a lever disposed at an opposite end of each mounting post, said lever having a locked position and an unlocked position, and being operably connected to said barrel, said openings ~~in~~^{said} adapters being sized to slidably receive one of said mounting posts and barrels therein when said lever is in the unlocked position, said barrel being moved into secure engagement with said adapter when said mounting post and barrel are positioned inside said opening and said lever is actuated into the

locked position, thereby preventing removal of said mounting post and barrel from said opening.

8. The backrest system as set forth in claim 2, wherein said back support includes a backing plate and an insert attached to a forwardly presented face of said backing plate 5 against which the back of the individual rests when sitting on the seat.

9. The backrest system as set forth in claim 8, wherein said backing plate is mounted to said horizontal tube by inserting at least one threaded bolt through an opening formed in said horizontal tube and through an aligned opening formed in said backing plate, said bolt being secured by a nut that is attached thereto.

10. The backrest system as set forth in claim 2, wherein said horizontal tube includes an opening extending axially therethrough, and is attached to each side plate by a mounting post that extends transversely and inwardly therefrom, said mounting post being adapted to be received in said opening of said horizontal tube.

11. The backrest system as set forth in claim 10 wherein each of mounting posts 15 includes a locking assembly for selectively securing said mounting posts to said horizontal tube.

12. The backrest system as set forth in claim 11 wherein said locking assembly includes a body portion with a tapered end and a tapered barrel that is secured to said body portion at said tapered end, said barrel being secured to said body portion by a threaded bolt 20 that extends through an axially extending opening formed in said body portion into said barrel, said barrel being moved axially inwardly and outwardly with respect to said body portion by said bolt, said barrel being moved inwardly into abutment with said tapered *end* *surface*

of said body portion and displaced radially outwardly so that edges of said tapered end of said body portion and said tapered barrel are wedged against ^{an} ~~said~~ inner surface of said horizontal tube when said bolt is tightened to securely retain said mounting posts inside said horizontal tubes, said barrel being ^{moved} ~~move~~ axially outwardly away from said tapered ^{end} ~~surface~~ of said body portion when said bolt is loosened so that edges of said tapered end of said body portion and barrel do not engage said inner surface of said tube and said mounting posts move freely inside said horizontal tubes.

14. The backrest system as set forth in claim 2, wherein two horizontal tubes are attached to and extend between said side plates in a substantially parallel manner, and further including a pair of vertically extending support tubes that are attached to and extend perpendicularly from said horizontal tubes in a substantially parallel fashion.

15. The backrest system as set forth in claim 14, wherein said back support includes a plurality of pads adjustably attached to said support tubes at desired locations along the support tubes based upon support needs of the individual.

16. The backrest system as set forth in claim 14, ¹⁵, wherein each pad is attached to at least one of the support tubes by an elbow joint that permits forward and rearward movement and side-to-side movement of the pad, said elbow joint including a first member having one end securely clamped to said support tube, and a second member attached at one end to said pad and at an opposite end to another end of said first member so that said first member rotates freely with respect to said second member.

17. 16. The backrest system as set forth in claim 15, wherein each pad is attached to the second member of said elbow joint by a ball and socket joint that permits rotary movement of the pad with respect to the second member.

13. 17. The backrest system as set forth in claim 11, wherein each of said horizontal tubes is attached to ~~said~~ vertical tubes by a pair of tube clamp assemblies that retain said horizontal tubes and said vertical tubes in a substantially perpendicular relationship and prevent rotational and longitudinal movement of said tubes.

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18. A backrest system for a chair for seating an individual, said chair having a seat and upright posts extending upwardly from the rear of the seat in a spaced apart, substantially parallel manner, said backrest system comprising:

a back support removably positioned between said posts to support the back of an individual sitting on the chair seat;

a support chassis disposed between said posts and mounted to said back support for supporting said back support at a desired incline with respect to said posts; and

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an attachment assembly mounted to each of said posts for releasably securing said support chassis to said posts.

19. The backrest system as set forth in claim 18, wherein said attachment assembly is attached to said posts at a desired location based upon the height of the individual.

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20. The backrest system as set forth in claim 18, wherein said support chassis is movable forwardly and rearwardly with respect to said posts to allow for positioning of said back support at a desired seat depth with respect to said seat.

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21. The backrest system as set forth in claim 20, wherein said support chassis further includes a pair of side plates disposed on opposite sides of said back support between said back support and said posts, each side plate having a horizontally extending slot formed therein to permit forward and rearward movement of said back support within said slots to adjust the seat depth.

22. The backrest system as set forth in claim 21, wherein said support chassis further includes a pair of swivel clamps mounted to said side plates having circumferentially extending slots formed therein to permit angular rotation of said back support with respect to said posts to adjust the incline of the back support.

10 23. The backrest system as set forth in claim 18 further including a pair of support tubes attached to said support chassis and extending vertically therefrom in a substantially parallel, spaced apart manner.

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24. The backrest system as set forth in claim 23 wherein said back support includes a plurality of pads mounted to said support tubes at desired locations based upon the support needs and proportions of the individual.

15 25. The backrest system as set forth in claim 24 wherein each of said pads is adjustable within at least five degrees of freedom, including movement of said pads inwardly, outwardly and laterally with respect to said support tubes and at forward and rearward inclines with respect to said support tubes to provide a support surface for the individual sitting on the seat based upon that individual's dimensions and support needs.

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26. The backrest system as set forth in claim 25 wherein each pad is attached to at least one of said support tubes by an elbow joint that permits inward, outward and lateral movement of said pad.

27. The backrest system as set forth in claim 26 wherein each pad is attached to 5 said elbow joint by a ball and socket joint, said ball and socket joint and said elbow joint allowing for movement of said pad within at least five degrees of freedom.

28. The backrest system as set forth in claim 27 wherein a first pad is attached to both support tubes via a pair of ball and socket joints and a pair of elbow joints to support the sacral region of the back of the individual seated in the chair.

10 29. The backrest system as set forth in claim 28 wherein two pads including a second pad and a third pad are provided to support the lumbar region of the individual's back, the second pad being attached to one support tube at a desired location via one ball and socket joint and one elbow joint, and the third pad being attached to the other support tube at a location corresponding to that of the second pad via one ball and socket joint and one elbow 15 joint.

30. The backrest system as set forth in claim 29 wherein said ball and socket joint and said elbow joint permit movement of said second pad and said third pad within six degrees of freedom

30. *31.* The backrest system as set forth in claim 29 wherein a fourth pad is attached to 20 both support tubes via a pair of ball and socket joints and a pair of elbow joints to provide support in the mid-thoracic region of the individual's back.

32. The backrest system as set forth in claim ~~31~~ wherein a headrest assembly is attached to said support tubes to provide support for the head of the individual seated in the chair.

33. The backrest system as set forth in claim ~~31~~ wherein a fifth pad assembly is attached to said support tubes to provide support for the upper-thoracic region of the individual's back.

34. The backrest system as set forth in claim 32 wherein said headrest assembly includes a mounting assembly that is removably secured to said support tubes, and a headrest pad against which the head of the individual rests when the individual is seated in the chair.

35. The backrest system as set forth in claim ~~34~~ wherein said mounting assembly permits rotary, lateral, forward and rearward movement of said headrest pad with respect to said support tubes.

36. The backrest system as set forth in claim ~~35~~ wherein said headrest assembly further includes at least one elbow joint that is attached to said mounting assembly at a desired location based upon the height and support needs of the individual.

37. The backrest system as set forth in claim 36 wherein said headrest pad is attached to said elbow joint by a ball and socket joint, said ball and socket joint and said elbow joint permitting movement of said headrest pad within five degrees of freedom.

38. The backrest system as set forth in claim ~~37~~ further including means for preventing movement of said headrest pad when said pad is disposed in a desired position.

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39. The backrest system as set forth in claim 18 wherein said back support includes a backing plate and an insert attached to a forwardly presented face of said backing plate against which the back of the user rests when sitting in the chair.

40. A backrest system for a chair for seating an individual, said chair having a seat 5 and a pair of upright posts extending upwardly from the rear of the seat in a spaced apart manner, said backrest system comprising:

a support frame structure releasably secured between said posts, said support frame being horizontally movable toward or away from said posts to position said support frame at a desired seat depth with respect to said seat; and

10 a back support mounted to said support frame structure to provide a surface against which the back of the individual rests when seated in the chair.

41. The backrest system as set forth in claim 40 wherein said support frame structure is rotatable forwardly and rearwardly with respect to said posts to position said back support at a desired incline with respect to said posts.

15 42. A backrest system for a chair for seating an individual, comprising: a pair of support tubes attached to a rear of said chair and extending vertically therefrom in a substantially parallel, spaced apart manner; and at least one back support pad attached to at least one of said support tubes at a desired location based upon the support needs and proportions of an individual sitting in the chair; said pad being coupled to said support tube by 20 at least one elbow joint, said elbow joint permitting inward, outward and lateral movement of said pad.

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43. The backrest system as set forth in claim 42 wherein each pad is attached to said elbow joint by a ball and socket joint, said ball and socket joint and said elbow joint permitting movement of said pad within at least five degrees of freedom with respect to said support tubes.

5 44. The backrest system as set forth in claim 42 wherein said elbow joint includes a first member including a first end having a first opening extending therethrough and a second end attached to said support tube, a second member having a first end coupled to said first end of said first member via a swivel attachment assembly, and a second end attached to said pad via said ball and socket joint, said swivel attachment device including a post 10 extending outwardly through an opening formed in the first end of the second member and through the first opening of the first member, and a retaining device attached to said post for preventing said post from becoming dislodged from said first and second members and permitting said first member to rotate freely about said post, said elbow joint further including a locking mechanism for selectively preventing rotation of said first member with respect to 15 said second member when said elbow joint is positioned at a desired orientation.

45. The backrest system as set forth in claim 44 wherein said locking mechanism includes a clamping device formed in said first end of said first member, said clamping device including a slot extending radially outwardly from said first opening through said first member, and a second opening formed in said first member and extending through said slot, 20 said second opening being adapted to accommodate a threaded stud that is held inside the opening by a nut, said clamping device exerting clamping force on said post when said

threaded stud is tightly secured inside said second opening by forcing said slot into a closed position and preventing rotation of said first member with respect to said second member.

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46. The backrest system as set forth in claim 43 wherein said ball and socket joint includes a ball having a first section and a second section, said second section being attached to said elbow joint, a socket having a cavity formed therein adapted to receive said ball, and means for radially moving said first section of said ball inwardly or outwardly with respect to said second section of said ball, said joint being in an unlocked position permitting rotation of said socket with respect to said ball when said first section is moved inwardly toward said second section, said joint being in a locked position preventing movement of said socket with respect to said ball when said first section is moved radially outwardly from said second section into engagement with said socket.

47. A backrest system for a chair for seating an individual, comprising: a pair of support tubes attached to a rear of said chair and extending vertically therefrom in a substantially parallel, spaced apart manner; and one or more back support pads attached to at least one of said support tubes at a desired location based upon the support needs and proportions of an individual sitting in the chair; said pad being attached to said support tube by a ball and socket joint that permits forward and rearward incline of said pad with respect to said support tube.

48. The backrest system as set forth in claim 47 further including an elbow joint connecting said ball and socket joint to said support tube, said elbow joint permitting inward, outward and lateral movement of said pad with respect to said support tube.

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49. The backrest system as set forth in claim 47 wherein said ball and socket joint includes a spherical ball including a first section and a second section, a socket having a spherical cavity formed therein that is sized to receive at least a portion of said ball, and means for radially moving said first section of said ball inwardly or outwardly with respect to said second section of said ball, said ball being in an unlocked position permitting rotation of said ball in said socket when said first section is in abutment with said second section of said ball, said ball being in a locked position preventing movement of said ball in said socket when said first section is moved radially outwardly from said second section into engagement with said socket.

10 50. The backrest system as set forth in claim 49 wherein said ball includes an opening extending radially through said second section, and said means for radially moving said first section includes a threaded stud attached to said first section of said ball and extending through said opening in said second section outwardly from said socket, said stud being movable within said opening inwardly to a retracted position and outwardly to an extended position, said ball being in the unlocked position when said stud is in the retracted position, said ball being in the locked position when said stud is in the extended position.

51. The backrest system as set forth in claim 50 wherein said first section of said ball is constructed from a nylon material.

52. The backrest system as set forth in claim 51 wherein said second section of said ball is constructed from a strong engineering plastic material.

53. The backrest system as set forth in claim 52 wherein said cavity in said socket is constructed from a strong engineering plastic material.

54. The backrest system as set forth in claim 53 wherein said second section of said ball is constructed from a strong engineering plastic material.

55. The backrest system as set forth in claim 54 wherein said socket further includes a C-ring bracket that is positioned around said ball disposed in said cavity; said 5 bracket exerting force of said ball when said ball is in the locked position to prevent rotation of said ball.

56. The backrest system as set forth in claim 55 wherein said bracket is constructed from a metal material.

57. The backrest system as set forth in claim 55 wherein said bracket is constructed 10 from a strong plastic material, said bracket having an inner edge that is adapted to frictionally engage said ball when said ball is in said locked position to prevent rotation of said ball.

58. A backrest system for a chair for seating an individual, comprising:
a pair of support tubes attached to a rear of said chair and extending vertically therefrom in a substantially parallel, spaced apart manner;
15 a back support attached to said support tubes to support the back of an individual sitting on the chair seat;
a headrest assembly removably mounted to said support tubes to support the head of the individual seated in the chair, including a mounting assembly that is removably secured to said support tubes, and a headrest pad attached to the mounting assembly against which the 20 head of the individual rests when the individual is seated in the chair.

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59. The backrest system as set forth in claim 58 wherein said mounting assembly permits forward and rearward movement of said headrest pad with respect to said support tubes.

60. The backrest system as set forth in claim 58 wherein said headrest assembly 5 further includes a pair of elbow joints that attach said headrest pad to said support tubes, said elbow joints permitting inward, outward and lateral movement of said headrest pad with respect to said support tubes, said elbow joints being attached to said mounting assembly at desired locations based upon the height and support needs of the individual.

61. The backrest system as set forth in claim 60 wherein said headrest pad is 10 attached to each elbow joint by a ball and socket joint, said ball and socket joint permitting rotary movement of said headrest pad.

62. A backrest system for a chair for seating an individual, comprising:
a pair of support tubes attached to a rear of said chair and extending vertically therefrom in a substantially parallel, spaced apart manner; and
15 a plurality of support pads to said support tubes to support the back of an individual sitting on the chair seat, said back support pads including a first pad attached to both support tubes to provide a first tier of support for the sacral region of the back of the individual seated in the chair, a pair of pads including a second and a third pad to provide a second tier of support for the lumbar region of the individual's back, said second pad being attached to one 20 support tube at a desired location and the third pad being attached to the other support tube at a location corresponding to that of the second pad, and a fourth pad attached to the support tubes to provide third tier of support for the mid-thoracic region of the individual's back.

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63. The backrest system as set forth in claim 62 wherein said support pads further include a fifth pad mounted on said support tubes to provide a fourth tier of support for the upper thoracic region of the individual's back.

5 64. The backrest system as set forth in claim 63 further including a headrest pad mounted on said support tubes to provide a fifth tier of support for the head of the individual.

65. The backrest system as set forth in claim 64 further including a plurality of pad covers with one pad cover removably positioned around each support pad.

10 66. The backrest system as set forth in claim 65 wherein said pad covers are constructed from a washable fabric material.

67. The backrest system as set forth in claim 65 wherein said pad covers wrap around each pad and are held in position by hook and loop fasteners.

68. The backrest system as set forth in claim 65 wherein said pad covers include an elastic band attached to an outer edge of said cover, said cover being slipped over the pad and held in place by said elastic band.

15 69. A backrest system for a chair for seating an individual, said chair having a seat and upright posts extending upwardly from the rear of the seat in a spaced apart, substantially parallel manner, said backrest system comprising:

20 a back support removably positioned between said posts to support the back of an individual sitting on the chair seat, including a backing plate and an insert attached to a forwardly presented face of said backing plate against which the back of the individual rests;

a support chassis disposed between said posts and mounted to said back support for supporting said back support at a desired incline with respect to said posts; and

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an attachment assembly mounted to each of said posts for releasably securing said support chassis to said posts.

70. The backrest system as set forth in claim 69 further including a back support cover removably positioned around said insert and at least a portion of said backing plate.

5 71. The backrest system as set forth in claim 70 wherein said cover is constructed from a washable fabric material.

72. The backrest system as set forth in claim 70 wherein said cover wraps around said back support and is held in position by hook and loop fasteners.

10 73. The backrest system as set forth in claim 70 wherein said cover includes an elastic band attached to an outer edge of said cover, said cover being slipped over the insert and backing plate and held in place by said elastic band.

74. A ball and socket joint comprising:

a ball including a first section and a second section;

a socket having a cavity formed therein that is sized to receive at least a portion of said

15 ball; and

means for moving said first section of said ball inwardly or outwardly with respect to said second section of said ball, said ball being in an unlocked position permitting rotation of said socket with respect to said ball when said first section is in abutment with said second section of said ball; said ball being in a locked position preventing movement of said socket with respect to said ball when said first section is moved radially outwardly from said second section into engagement with said socket.

75. The ball and socket joint of claim 74 wherein said ball includes an opening extending radially through said second section.

76. The ball and socket joint of claim 75, wherein said means includes a threaded stud attached to said first section of said ball and extending through said opening in said second section outwardly from said socket, said stud being movable within said opening inwardly to an extended position and outwardly to a retracted position, said ball being maintained in the unlocked position when said stud is in the retracted position, said ball being maintained in the locked position when said stud is in the extended position.

77. The ball and socket joint as set forth in claim 74 wherein said first section of said ball is constructed from a nylon material.

78. The backrest system as set forth in claim 77 wherein said second section of said ball is constructed from a strong engineering plastic material.

79. The backrest system as set forth in claim 78 wherein said cavity in said socket is formed in a strong engineering plastic material.

80. The backrest system as set forth in claim 79 wherein said socket further includes a C-ring bracket that is positioned around said ball disposed in said cavity, said bracket exerting force of said ball when said ball is in the locked position to prevent rotation of said ball.

81. The backrest system as set forth in claim 80 wherein said bracket is constructed from a metal material.

82. The backrest system as set forth in claim 81 wherein said bracket is constructed from a strong engineering plastic material, said bracket having an inner edge that is adapted to

frictionally engage said ball when said ball is in said locked position to prevent rotation of said ball.

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83. A ball and socket joint comprising:

a substantially spherical ball including a first section, a second section, a threaded

5 opening extending radially through said second section of said ball;

a socket having a cavity formed therein that is sized to receive a portion of said ball;

a threaded stud attached to said first section of said ball and extending through said opening in said second portion outwardly from said socket, said stud being movable within said opening inwardly to an extended position and outwardly to a retracted position, said 10 stud moving said first section of said ball into abutment with said second section when said stud is in the retracted position to permit said ball to rotate freely in said socket, said stud moving said first section of said ball outwardly away from said second section into engagement with said socket when said stud is in the extended position to prevent rotation of said ball in said socket.

15 84. The ball and socket joint as set forth in claim 83, wherein said socket includes a base having said cavity formed therein, and a C-shaped bracket secured to said base when said ball is positioned inside said cavity, said bracket having an inner edge positioned around a portion of said ball, said stud extending outwardly through said bracket and permitting limited rotation of said ball in said socket when said stud is in the retracted 20 position, said inner edge of said bracket engaging said ball when said stud is in the extended position to prevent rotation of said ball in said cavity.

84. 85. The ball and socket joint as set forth in claim 84 wherein said first section of
said ball is constructed from a nylon material.

86. 87. The ball and socket joint as set forth in claim 85 wherein said second section of
said ball is constructed from a strong engineering plastic material.

5 88. 87. The ball and socket joint as set forth in claim 86 wherein said base of said
socket is formed in a strong engineering plastic material.

89. 88. The backrest system as set forth in claim 87 wherein said bracket is constructed
from a metal material.

10 89. The backrest system as set forth in claim 87 wherein said bracket is
constructed from a strong plastic material, said inner edge of said bracket being adapted to
frictionally engage said ball when said stud is in the extended position.

90. 88. An elbow joint comprising:
a first member including a first end having a first opening extending therethrough;
a second member having a first end coupled to said first end of said first member;
15 a swivel attachment device coupling said first member to said second member,
including a post extending outwardly through an opening formed in the first end of said
second member and through said first opening in said first member, and a retaining device
attached to said post for preventing said post from becoming dislodged from said first
opening and permitting said first member to rotate freely around said post;

20 a locking mechanism for selectively preventing rotation of said first member with
respect to said second member when said elbow joint is positioned at a desired orientation.

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91. The elbow joint as set forth in claim 90 wherein said locking mechanism includes a clamping device formed in said first end of said first member, said clamping device including a slot formed in said first member and extending radially outwardly from said first opening, and a second opening formed in said first member and extending through 5 said slot, said second opening being adapted to accommodate a threaded stud therein, said stud being held in place by a nut, said clamping device exerting clamping force on said post when said threaded stud is tightly secured inside said second opening by forcing said slot into a closed position and preventing rotation of said first member with respect to said second member.

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